Claims

1. A method of metabolic rate measurement for an individual, the method comprising the steps of:

measuring an exhaled gas volume for the individual using a spirometer having a flow path enclosed by a flow tube, and a flow sensor disposed in the flow path for sensing the exhaled gas flow from the individual, a display and a processor having a memory that processes a signal from the flow sensor;

determining a respired gas volume for the individual using the exhaled gas volume and a ventilatory equivalent; and

determining a metabolic rate for the individual from the respired volume.

2. The method of claim 1, including the step of using the ventilatory equivalent for oxygen, wherein the ventilatory equivalent is determined from a predetermined calibration relationship between oxygen consumed by the individual as a function of exhaled gas volume.

3. The method of claim 1, including the step of using the ventilatory equivalent for oxygen, wherein the ventilatory equivalent for oxygen is determined from predetermined demographic data related to the individual stored in the memory of the processor.

4. The method of claim 1, including the step of determining a ventilatory equivalent while the individual is at rest and using the resting ventilatory equivalent and the exhaled volume to determine a resting metabolic rate.

5. The method of claim 4, including the step of determining a ventilatory equivalent while the individual is exercising and using the exercise ventilatory equivalent and the exhaled volume to determine an exercise metabolic rate.

6. The method of claim 5 including the step of determining an activity energy expenditure for the individual during exercise by determining an exercise metabolic rate for the individual during the exercise using the exercise ventilatory equivalent and determining the activity energy expenditure for the exercise by subtracting the resting metabolic rate of the person from the exercise metabolic rate.

7. The method of claim 6, including the step of determining a total energy expenditure as a sum of the resting energy expenditure and the activity energy expenditure for the individual.

8. The method of claim 7 wherein the resting energy expenditure is determined using a gas exchange monitor.

9. The method of claim 1, including the step of determining a ventilatory equivalent while the individual is exercising and using the exercise ventilatory equivalent and the exhaled volume to determine an exercise metabolic rate.

10. The method of claim 1, including the step of determining the ventilatory equivalent for carbon dioxide and using the ventilatory equivalent for carbon dioxide in determining the metabolic rate.

11. The method of claim 1, wherein said step of using the ventilatory equivalent includes the step of determining the ventilatory equivalent from a physiological parameter of the individual.

12. The method of claim 1, including the step of determining if the individual's breathing is normal before measuring the exhaled gas volume.

13. The method of claim 1, wherein the ventilatory equivalent is determined for the person using an indirect calorimeter adapted to be worn by the person during performance of an exercise.

14. The method of claim 1 including the step of initially determining a ventilatory equivalent using an indirect calorimeter.

15. A method of determining the resting metabolic rate of a person using a flow meter, the method comprising:

measuring an exhaled volume for the person using the flow meter;

determining a consumed volume of oxygen from the exhaled volume using a ventilatory equivalent for oxygen, the ventilatory equivalent for oxygen being determined in an initial procedure; and

determining the resting metabolic rate from the consumed value of oxygen.

16. The method of claim 15, wherein the initial procedure includes the step of measuring the ventilatory equivalent for oxygen by determining exhaled flow volumes and consumed oxygen volumes.

17. A method of determining a metabolic rate of a person, the method comprising the steps of :

determining an exhaled volume;

determining a component gas average concentration in the exhaled volume, wherein the component gas is either oxygen or carbon dioxide;

determining a component gas exhaled volume from the component gas average concentration and the exhaled volume;

estimating an inhaled volume for the person;

determining a component gas inhaled volume from the inhaled volume and a component gas inhaled concentration;

determining a difference volume between the component gas inhaled volume and the component gas exhaled volume; and

determining the metabolic rate of the person using the difference volume.

18. A spirometer for determining a metabolic rate for an individual comprising:

a flow path;

a flow sensor disposed in said flow path, wherein said flow sensor senses a flow rate of exhaled gas from the individual through said flow path;

a processor having a memory in communication with said flow sensor; wherein said processor receives a signal from said flow sensor of flow rate, integrates the flow rate data, and determines a metabolic rate from a ventilatory equivalent and the flow rate measurement.

19. The spirometer of claim 18 further comprising a data entry mechanism.

20. The spirometer of claim 18 further comprising a display for displaying the determined metabolic rate.

21. The spirometer of claim 18, further comprising a pressure sensor, wherein a measured pressure is used to correct the flow volume of exhaled gas to a standard pressure.

22. The spirometer of claim 15, wherein said flow sensor is an ultrasonic transducer for measuring temperature, humidity and pressure.

23. The spirometer of claim 18, wherein said spirometer is operatively in communication with a personal digital assistant.

24. The spirometer of claim 18, further comprising a capnometer for measuring a flow volume of CO_2, and the ratio of exhaled volume to carbon dioxide production volume is used to determine the ventalatory equivalent for carbon dioxide.

25. The spirometer of claim 18 further comprising a temperature sensor 40 for measuring the temperature of the exhaled gas.

26. The spirometer of claim 18 further comprising a wireless network connection for communication with a central health network over a communications network.

27. A spirometer for determining a metabolic rate for an individual comprising:

a flow path;

a flow sensor disposed in said flow path, wherein said flow sensor senses a flow rate of exhaled gas from the individual through said flow path;

a mixing chamber integral with said flow path and a gas component sensor disposed in said mixing chamber for sensing a composition of the exhaled gas, wherein the gases passing through the mixing chamber are mixed together;

a processor having a memory in communication with said gas component sensor and said flow rate sensor; wherein said processor receives a signal from said flow sensor of flow rate and a signal from said gas component sensor that correlates the average concentration of the gas component within the respiration, integrates the flow rate data, determines oxygen consumption by subtracting the inhaled oxygen volume from the exhaled oxygen volume and determines a metabolic rate from the oxygen consumption.

28. A spirometer as set forth in claim 27 wherein said mixing chamber stores a plurality of breaths for determining an average oxygen component concentration for a plurality of exhalations.

29. A spirometer as set forth in claim 27 further comprising a mouthpiece with an aperature transmitting air into the flow path.

30. A spirometer as set forth in claim 27 further comprising an inhalation valve and an exhalation valve disposed between said mouthpiece and said flow path, wherein inhaled air passes through said inhalation valve and exhaled air passes through said exhalation valve.